CHAPTER 4

IN-PLANT FISH ASSESSMENT

2009

INTRODUCTION

This chapter reports on fish impingement at the San Onofre Nuclear Generating Station (SONGS) in compliance with National Pollutant Discharge Elimination System (NPDES) requirements. The term "impingement" refers to entrapped fish that are killed in the SONGS cooling system and are removed by traveling screens. This chapter summarizes in-plant fish collection data for the year 2009 at San Onofre Units 2 and 3. San Onofre Unit 1 was taken out of service in 1992 and did not operate in 2009. Its NPDES permit has been rescinded and the Unit is not considered in this report.

Fish enter Units 2 and 3 of the station via seawater intakes supplying cooling water to the station. Most of the fish are guided through the intake screenwell to the fish return system and are returned to the ocean alive. Those remaining are impinged on the traveling screens and are deposited in containers for disposal. Estimates of the total number and weight of fish impinged during normal plant operation, including heat treatment, and analysis of size (age) and sex composition of select impinged species are presented in this report for Units 2 and 3 at SONGS.

Also included in this chapter is a report on the operation and effectiveness of "Fish Chase" procedures carried out in 2009 as a means of increasing fish survival at SONGS. The "Fish Chase" is a procedure used at SONGS to remove as many fish as possible from the circulating water system before heat treatment procedures are conducted. Heat treatment procedures are necessary to eliminate fouling organisms from colonizing within the cooling water system[1].

This report also includes a historical review of Fish Return System (FRS) effectiveness based on past studies.

METHODS

The analytical approach for this section utilizes tabular summaries of the number of individuals and biomass of fish impinged during normal operations and heat treatments. The total annual normal operation catch is calculated by multiplying the total number and weight of fish sampled during 24-hour sample periods by the total amount of sea water pumped during each month of the year divided by the amount of water sampled during the 24-hour

[1] Information in this report regarding the Fish Chase procedure also meets requirements of Condition B of the Coastal Development Permit for SONGS (permit no. 6-81-330-A, formerly 183-73) issued by the California Coastal Commission.

samples. Fish collected during heat treatments are added to the total for the month during which they occurred. The months, January through December, are summed to give the annual total for each unit.

In 1999, a new NPDES permit was issued to the San Onofre Nuclear Generating Station that reduced the requirement for fish impingement monitoring from monthly sampling to quarterly sampling. This change went into effect in August 1999. For this reason, normal operation samples were taken during each of the four calendar quarters in 2009 (January-March; April-June; July-September; and October-December). Monthly impingement was estimated by assuming the quarterly normal operation samples were representative of each of the days in the sampled quarter. Heat treatment fish loss is then added to the months during which the heat treatments occurred. A list of all samples is provided in Appendix A.

Length-frequency distributions of select species impinged in 2009 are constructed using samples of a maximum of 125 individuals for each normal operation and heat treatment sample. Fish were measured to the nearest millimeter. Sex ratios are estimated based on sub-samples of a maximum of 50 individuals per sample.

Heat Treatment Samples

Heat treatments at San Onofre involve recirculating approximately two-thirds of the normal discharge flow back through the condenser to achieve a temperature of 105°F (41°C) in the screenwell to control the growth of fouling organisms, especially mussels and barnacles. The intake conduit is heat treated in this manner on an as-required schedule based upon a biofouling growth model (LCMR 1977) and operational requirements of the plant. During the heat treatment process, fish residing in the screenwell die due to the elevated temperatures. The dead fish are removed by screens and collected by biologists who separate them by species. They are then counted, weighed, and sub-samples are processed for length and sex determination.

Fish Chase

A "fish chase" procedure has been developed at SONGS to reduce the impact on fish populations by minimizing the number of fish killed during heat treatments. The fish chase is a procedure unique to SONGS. It was developed to allow live fish to move out of the circulating water system before beginning the heat treatment. Many of these fish accumulate in the cooling water system between heat treatments, often residing in habitat provided by gate slots and other structures within the system. The fish chase is accomplished by slowly manipulating cross-over gates in the vicinity of the screenwell, where most of the fish reside. This operation re-circulates effluent water so that the water is slowly warmed. The gate manipulations also create eddy currents that will dislodge fish that have congregated in areas of low flow. The elevated temperatures and new flow patterns are intended to agitate fish enough that they will seek new habitat and will find their way into the fish return elevator for release back to the ocean. Without the fish chase procedure, all fish residing in the circulating water system at the time of the heat treatment likely would be killed. The fish chase is monitored by biologists to assure that the fish are not overly stressed by the

procedure. Engineers, operators and biologists are continuing to improve on the effectiveness of the fish chase by experimenting with various combinations of temperature and gate changes and the length of the fish chase.

Normal Operation

Normal plant operation samples of fish are collected according to the frequency required by the station's NPDES permit, except during periods when the units are not in service due to refueling or maintenance. In 2009, estimates of normal operation impingement were based on quarterly samples, as required by the Stations' NPDES permit. These 24-hour samples are intended to be representative of the amount of fish that enter the plant during a "normal" day's operation. In 2009, samples were taken quarterly in March, May, September and December. Overall, there were four 24-hour normal operation samples at each of the Units.

Fish Return System

At Units 2 and 3, fish are guided via vanes and louvers to the fish return chamber where an elevator raises them to the surface of the intake screenwell and releases them via a sluiceway back to the ocean. Previously reported studies (SCE, 1988; Love, *et al*, 1989) assessed the effectiveness and survivorship of the fish return system. In 1999, additional studies of the fish return system were conducted as part of a special study for the California Coastal Commission. In 2006 and 2007 the efficiency of the FRS was once again examined as a part of the 316(b) study program, when samples were taken approximately bi-weekly, concurrent with normal operation samples. No additional samples were taken in 2009.

The fish return system is operated by equipment operators at least twice daily and operations are logged on daily status sheets (Form SO123-0-10) (M. J. Johnson, Personal Communications).

Data Analysis

Analysis of impingement catch involves (1) estimating the catch of all fish species occurring during the year, (2) describing the length-frequency distributions of commonly occurring species, and (3) describing sex ratios of commonly occurring species. All weight, count, length measurement and gender determination data are provided in the 2009 Annual Data Report. This chapter of the Analysis Report presents catch data for the 15 most common species and length and sex data for species believed to be of particular interest to resource managers, assuming sufficient data exists for meaningful analysis. The calculation used to determine the annual impingement catch in weight and numbers of fish during normal operation and heat treatment was described earlier in this section.

The number of fish released during the fish chase procedures are estimated by visual counts from biologists as the fish are raised in the fish return elevator. Fish are not netted or captured for processing since this would negate the benefit of the procedure. Biomass is determined by applying the values measured for fish of the same species taken in the

subsequent heat treatment samples. That is, fish returned via the fish return system are assumed, on average, to weigh the same as fish taken in the following heat treatment. This results in a conservative estimate of biomass since returned fish tend to be larger than impinged fish.

Size structure and sex ratios of select species are examined using length-frequency histograms and sex ratio tables developed from data gathered during impingement sampling.

RESULTS AND DISCUSSION

Summary of Plant Operations

The monthly operational status of each unit in 2009, based on cooling water flow volume, is summarized in Table 4-1. The table shows the number of gallons of seawater pumped per month. The amount of power produced at the station is not necessarily related to the volume of seawater pumped. This is because circulating water pumps may have to be operated even when the station is not producing power and the pumps operate at only one speed whereas the plant may not always be run at maximum capacity.

Table 4-1. Monthly Circulating Water Flow in 2009

Month	Unit 2 10^6 gallons	Unit 3 10^6 gallons
January	19,229	37,776
February	26,675	34,120
March	37,776	37,776
April	36,558	36,558
May	37,776	37,776
June	36,558	36,558
July	37,776	37,776
August	37,776	37,776
September	33,908	36,558
October	187	37,776
November	13,099	36,558
December	13,722	37,776
Total	331,039	444,784

Annual Impingement Estimate

Unit 1

Unit 1 is no longer in service.

Unit 2

The 2009 annual impingement estimate for Unit 2 is based on four 24-hour "normal operation" impingement samples and eight heat treatment samples conducted during the year. Appendix A lists all normal operation, heat treatment and fish chase samples collected at Unit 2 and Unit 3 in 2009. Table 4-2 shows the estimated monthly abundance of the 15 most abundant fish species and all species combined in 2009. Table 4-3 presents the estimated monthly biomass of the top 15 fish species by weight in kilograms. Monthly abundance and biomass of all species occurring at SONGS Unit 2 in 2009 are presented in detail in Appendices B and C, respectively.

A total of 58 species of fish were counted and weighed at Unit 2 in 2009. When weighted by the total amount of seawater used by Unit 2 in 2009, the estimated fish impingement was 1,137,642 individuals weighing 33,720 kilograms. The top 15 species accounted for 99.77% of the total number and 99.68% of the total weight. Pacific sardine were the most numerous species contributing 91.05% of the total number and also contributed the most biomass with 31,944 kilograms. Queenfish ranked second in numbers of individuals (50,828) accounting for 4.47% of the total count while northern anchovy contributed the second most weight (486 kilograms), or 1.44% of the total biomass.

Unit 3

The 2009 annual impingement estimate for Unit 3 is based on four 24-hour "normal operation" impingement samples and eight heat treatment samples conducted during the year. Table 4-4 shows the estimated monthly abundance of the 15 most abundant fish species and all species combined in 2009. Table 4-5 presents the estimated monthly biomass of the top 15 fish species by weight in kilograms. Monthly abundance and biomass of all species occurring at SONGS Unit 3 in 2009 are presented in detail in Appendix D and E, respectively.

A total of 68 species of fish were counted and weighed at Unit 3 in 2009. When weighted by the total amount of seawater used by Unit 3 in 2009, the estimated fish impingement was 926,875 individuals weighing 25,255 kilograms. The top 15 species accounted for 99.00% of the total number and 98.92% of the total weight. Pacific sardines were the most numerous species contributing 59.37% of the total number of fish. Pacific sardines also contributed the greatest weight with 79.09% of the total biomass.

Table 4-2. Estimated Monthly Count of Fish Impinged at Unit 2 in 2009

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% of Total
Pacific sardine	631	944	1274	340322	351664	340669	93	93	100	-	21	23	1035835	91.05%
queenfish	2903	4283	5784	1042	682	1276	12018	11005	11214	4	301	315	50828	4.47%
northern anchovy	458	827	900	8775	8308	12224	1147	1147	1130	6	408	428	35757	3.14%
plainfin midshipman	805	1117	1582	-	-	-	-	-	-	-	-	-	3504	0.31%
jack mackerel	16	547	91	130	124	952	237	-	451	-	-	-	2548	0.22%
white croaker	79	110	155	6	-	3	218	217	199	-	-	-	987	0.09%
topsmelt	63	175	144	120	124	190	38	31	68	-	-	-	953	0.08%
kelp pipefish	95	135	186	120	124	120	31	31	28	-	21	23	914	0.08%
deep body anchovy	-	41	-	-	-	-	93	93	109	3	193	203	735	0.06%
giant kelpfish	63	91	126	64	62	61	63	62	60	-	-	-	651	0.06%
salema	47	72	104	70	-	187	40	31	63	-	-	-	614	0.05%
slough anchovy	-	10	1	-	-	-	186	186	177	-	21	23	604	0.05%
California scorpionfish	16	30	35	70	62	73	34	31	30	-	-	-	380	0.03%
jacksmelt	16	72	113	41	-	43	31	31	30	-	-	-	376	0.03%
Pacific pompano	79	111	155	3	-	2	-	-	5	-	-	-	355	0.03%
Total of top 15 species	5192	8453	10495	350760	361150	355798	14229	12958	13658	13	967	1013	1134687	99.77%
Total of all 58 species	5539	9015	11209	350926	361212	356001	14638	13051	13967	14	1010	1058	1137642	100.00%

Table 4-3. Estimated Monthly Weight (Kgs) of Fish Impinged at Unit 2 in 2009

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% of Total
Pacific sardine	24.222	37.101	49.735	10485.145	10834.562	10502.098	3.131	3.131	3.666	0.012	0.817	0.856	31944.476	94.73%
northern anchovy	2.477	5.812	4.879	129.050	120.280	193.380	0.496	0.496	0.617	0.200	14.018	14.684	486.389	1.44%
queenfish	40.443	76.704	80.417	12.776	6.572	20.150	45.342	30.752	39.928	0.016	1.139	1.194	355.433	1.05%
California electric ray	-	-	-	-	-	-	-	-	-	1.351	94.599	99.092	195.042	0.58%
jack mackerel	0.931	32.352	5.475	5.885	5.642	62.060	16.936	-	38.549	-	-	-	167.830	0.50%
plainfin midshipman	34.305	47.634	67.448	-	-	-	-	-	-	-	-	-	149.387	0.44%
yellowfin croaker	-	0.109	-	1.200	-	0.116	106.900	-	0.231	-	-	-	108.556	0.32%
giant seabass	-	-	42.000	-	-	-	-	-	-	-	-	-	42.000	0.12%
topsmelt	1.988	6.908	4.652	5.820	6.014	7.722	1.072	0.806	2.448	-	-	-	37.431	0.11%
California butterfly ray	3.361	4.663	6.603	0.133	-	-	6.386	6.386	5.732	-	-	-	33.264	0.10%
jacksmelt	0.726	5.907	8.196	3.027	-	5.004	2.139	2.139	2.093	-	-	-	29.231	0.09%
salema	1.736	2.562	3.726	1.900	-	6.434	0.444	0.062	2.132	-	-	-	18.995	0.06%
chub mackerel	0.000	0.347	0.114	0.072	-	0.590	5.146	5.146	4.785	-	-	-	16.200	0.05%
California scorpionfish	1.373	3.154	3.335	0.720	0.124	0.607	1.473	1.395	1.526	-	-	-	13.707	0.04%
kelp pipefish	0.821	1.170	1.612	2.280	2.356	2.280	0.992	0.992	0.890	0.001	0.064	0.068	13.526	0.04%
Total of top 15 species	755.07	783.37	899.07	1110.27	1277.90	1110.27	430.93	317.56	249.62	2905.40	2799.27	2988.53	33611.467	99.68%
Total of all 58 species	123.334	245.731	300.942	10658.847	10976.542	10812.560	203.015	53.723	114.705	1.600	112.035	117.357	33720.392	100.00%

Table 4-4. Estimated Monthly Count of Fish Impinged at Unit 3 in 2008

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% of Total
Pacific sardine	2294	2833	2294	176478	183706	176460	157	166	151	1922	1861	1922	550244	59.37%
queenfish	23064	22765	23064	1478	2148	1320	19161	19657	20243	40486	40985	40486	254857	27.50%
northern anchovy	4061	4209	4061	13475	13857	4020	2978	3045	2901	6882	6727	6882	73098	7.89%
plainfin midshipman	3689	3333	3689	106	64	60	-	1	-	-	-	-	10942	1.18%
deep body anchovy	31	45	31	7	-	-	713	713	732	1736	1728	1736	7472	0.81%
jack mackerel	-	197	-	41	1339	-	1568	203	501	-	174	-	4023	0.43%
slough anchovy	-	2	-	-	-	-	248	248	241	744	724	744	2951	0.32%
Pacific pompano	651	603	651	2	0	-	32	32	34	-	2	-	2007	0.22%
white croaker	341	310	341	7	12	-	186	186	182	124	126	124	1939	0.21%
salema	186	174	186	225	85	-	102	288	185	-	450	-	1881	0.20%
giant kelpfish	124	115	124	120	127	120	250	249	243	124	126	124	1846	0.20%
sargo	-	-	-	1	-	-	99	394	1004	62	144	62	1766	0.19%
speckled sanddab	434	396	434	120	124	120	-	-	-	-	1	-	1629	0.18%
white seabass	-	-	-	-	-	-	496	500	488	-	2	-	1486	0.16%
topsmelt	0	107	-	148	258	120	328	77	83	62	230	62	1475	0.16%
Total of top 15 species	34,875	35,089	34,875	192,208	201,720	182,220	26,318	25,759	26,988	52,142	53,280	52,142	917,616	99.00%
Total of all 68 species	35,650	36,004	35,650	192,924	202,460	182,580	27,174	26,902	28,071	52,638	54,184	52,638	926,875	100.00%

Table 4-5. Estimated Monthly Weight (Kgs) of Fish Impinged at Unit 3 in 2009

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% of Total
Pacific sardine	79.267	109.655	79.267	6353.100	6625.299	6352.200	5.420	5.780	5.200	120.900	117.035	120.900	19974.023	79.09%
queenfish	365.180	345.150	365.180	21.676	35.488	16.800	105.255	111.619	107.618	145.700	149.835	145.700	1915.201	7.58%
California electric ray	249.550	230.350	249.550	-	-	-	-	-	-	-	29.100	-	758.550	3.00%
northern anchovy	48.701	47.278	48.701	216.026	229.090	59.760	8.061	8.195	7.883	17.856	17.590	17.856	726.997	2.88%
plainfin midshipman	155.000	140.003	155.000	4.870	1.849	1.680		0.014	-	-	-	-	458.416	1.82%
jack mackerel	-	10.750	-	2.230	84.012	-	104.720	29.846	40.600	-	15.350	-	287.508	1.14%
sargo	-	-	-	0.016	-	-	1.386	158.962	95.230	0.186	14.100	0.186	270.066	1.07%
yellowfin croaker	-	-	-	-	-	-	1.682	90.082	21.950	-	8.260	-	121.974	0.48%
bat ray	41.013	37.044	41.013	-	-	-	-	-	-	-		-	119.070	0.47%
salema	4.526	4.170	4.526	6.815	3.262	-	1.855	19.093	15.790	-	15.300	-	75.337	0.30%
Pacific herring	25.482	23.016	25.482	0.028	-	-	-	-	-	-	-	-	74.008	0.29%
California scorpionfish	14.043	12.828	14.043	6.950	0.333	-	0.969	0.507	0.933	0.930	2.299	0.930	54.765	0.22%
deep body anchovy	0.279	0.421	0.279	-	-	-	7.688	7.688	7.971	9.486	9.674	9.486	52.972	0.21%
topsmelt	-	3.530	-	5.625	9.425	4.380	10.788	2.208	2.264	1.488	9.040	1.488	50.236	0.20%
giant kelpfish	5.115	4.728	5.115	6.969	6.965	6.600	1.468	1.434	1.541	1.116	1.467	1.116	43.634	0.17%
Total of top 15 species	988.16	968.92	988.16	6624.31	6995.72	6441.42	249.29	435.43	306.98	297.66	389.05	297.66	24982.76	98.92%
Total of all 68 species	1014.01	1005.01	1014.01	6659.49	7020.17	6448.62	270.74	476.77	338.21	301.85	403.98	301.85	25254.70	100.00%

Heat Treatment Operations and Fish Chase.

Heat treatments are conducted on an "as needed" basis at coastal generating stations to control the growth of fouling organisms such as mussels and barnacles. The timing of these operations is dependent on season, ocean temperature, and observed settlement and growth of fouling organisms. The operations typically occur about every six weeks. The water temperature within the station is elevated to a temperature that will be lethal to the fouling organisms within the plant. Since this temperature is also lethal to fish residing in the station, a special operation called the fish chase has been developed at San Onofre to increase the number of fish returned to the ocean alive prior to a heat treatment. Table 4-6 summarizes the number and weight of fish returned to the ocean during the fish chase that occurs just prior to the heat treatment and the percent of those fish returned to the ocean compared to the number of fish killed during the heat treatment process at SONGS Units 2 and 3.

In 2009, a total of 2,016.67 kgs of fish were impinged during heat treatment operations at SONGS. At the same time, as a result of the "Fish Chase" procedure, 2,436.20 kgs of fish were successfully released back to the ocean prior to the heat treatments. The percentage of fish released varied among the heat treatments, but averaged 54.7% for the year. The percent of fish released during each fish chase varied from 12.7% to 85.5% of the total (i.e., fish chase divided by heat treatment plus fish chase) biomass.

Table 4-6. Fish Chase Efficiency by Heat Treatment for Units 2 and 3 in 2009

Unit	Date	Fish Chase Kilograms	Heat Treatment Kilograms	Percent Released
Unit 2	2/21/2009	178.26	74.639	70.5%
Unit 2	3/14/2009	8.5	58.646	12.7%
Unit 2	4/25/2009	44.26	36.387	54.9%
Unit 2	6/6/2009	223.12	190.1	54.0%
Unit 2	7/19/2009	397.768	149.292	72.7%
Unit 2	9/5/2009	219.186	37.292	85.5%
Unit 2	9/9/2009	30.481	23.602	56.4%
Unit 2	9/13/2009	9.87	5.59	63.8%
Unit 2 Totals		**1111.45**	**575.55**	**65.9%**
Unit 3	2/14/2009	85.725	89.126	49.0%
Unit 3	4/10/2009	45.107	210.873	17.6%
Unit 3	5/23/2009	206.62	313.368	39.7%
Unit 3	5/25/2009	32.14	43.228	42.6%
Unit 3	7/3/2009	117.384	130.681	47.3%
Unit 3	8/15/2009	421.985	339.309	55.4%
Unit 3	9/24/2009	194.632	202.669	49.0%
Unit 3	11/19/2009	221.166	111.869	66.4%
Unit 3 Totals		**1324.76**	**1441.12**	**47.9%**
Overall Totals		**2,436.20**	**2,016.67**	**54.7%**

Table 4-7. Description of Fish Chase Operations in 2009

					Elevator					Heat Treatment		
Unit	Date	Start Time	Intake Temp.	Max FC Temp.	Operational Status	# of Dumps	Condition of fish	No. of Fish	Fish Weight	No. of Fish	Fish Biomass	Comment
2	2/21/09	0321	59	79	Normal	16	Good	1408	178.26	1332	74.639	
2	3/14/09	2240	58	81	Normal	9	Good	209	8.5	328	58.646	
2	4/25/09	1600	60.2	81	Normal	12	Good	295	44.26	1366	36.387	Dead seal removed
2	6/6/09	1542	60	64	Normal	15	Good	2428	223.12	6441	190.1	
2	7/19/09	1151	62	85	Normal	25	Good	1339	397.77	1587	149.292	
2	9/5/09	1530	75	86.5	Normal	15	Good	2061	219.19	1268	37.292	
2	9/9/09	0250	74	85.5	Normal	23	Good	336	30.481	752	23.602	
2	9/13/09	1004	72	88	Normal	15	Good	720	9.87	233	5.59	
3	2/14/09	2019	58	82	Normal	16	Good	1508	85.725	3804	89.126	
3	4/10/09	1542	60	80.5	Normal	17	Good	2204	45.107	10344	210.873	
3	5/23/09	1512	66	85	Normal	15	Good	2773	206.62	12638	313.368	Harbor seal; HT cancelled
3	5/25/09	1525	65.7	85	Normal	11	Good	653	32.14	1156	43.228	
3	7/3/09	1207	61	83.4	Normal	20	Good	1655	117.38	2281	130.681	Seal cage in >48 hr.
3	8/15/09	1147	69	86.2	Normal	18	Good	1500	421.99	2009	339.309	
3	9/24/09	1008	65	87	Normal	22	Good	1575	194.63	3981	202.669	
3	11/19/09	0337	62.9	84	Normal	16	Good	2623	221.17	3244	111.869	

In Table 4-7 above, "Operational Status" provides information on the overall success of the fish chase procedure from an operational standpoint, i.e., whether it was completed as scheduled or not. "Condition of Fish" is a qualitative evaluation of how the fish appeared as they were released. A designation of "Good" means that less than 5% of the fish released appeared weakened or dead. The target temperature for a fish chase is usually 83°F. (28.3° C.) However, higher temperatures may be necessary to remove warm water species such as yellowfin croaker, sargo and zebra perch. In 2009, maximum temperatures ranged from 79° to 87° F. (26.1° to 30.6° C.). Graphs of temperature curves for each fish chase are presented in Appendix F. Table 4-8 presents a summary of fish released during the Fish Chase operations in 2009. The table provides the percent returned by numbers and biomass for the 15 most common species based on biomass. Appendix G provides the same information for all species taken at SONGS in 2009. Appendix H lists observations of species that may be of special interest to some researchers and resource managers.

Table 4-8. Summary of Fish Released During Fish Chase Operations in 2009 (Top 15 Species by Count)

	Unit 2 Fish Chase		Unit 2 Heat Treat		Unit 3 Fish Chase		Unit 3 Heat treat		% Returned	% Returned
Common Name	Number	Kgs	Number	Kgs	Number	Kgs	Number	Kgs	by Count	by Biomass
northern anchovy	725	2.091	5212	92.189	3341	41.655	19858	327.52	13.96%	9.44%
queenfish	1193	72.258	3682	68.685	1486	14.96	7713	77.333	19.04%	37.39%
jack mackerel	3028	212.421	2115	147.216	3785	305.182	4023	287.51	52.61%	54.35%
Pacific sardine	257	12.93	470	23.629	1681	70.12	2158	100.93	42.44%	40.00%
salema	786	36.429	318	11.262	1974	126.882	1157	61.921	65.17%	69.06%
sargo	865	65.289	69	9.485	632	151.457	1306	268.96	52.12%	43.77%
yellowfin croaker	662	350.577	187	108.556	255	68.038	422	119.95	60.09%	64.69%
spotfin croaker	458	53.177	8	1.539	623	162.872	39	13.221	95.83%	93.61%
topsmelt	6	0.188	224	8.789	9	0.416	743	27.934	1.53%	1.62%
jacksmelt	303	28.42	218	19.874	95	8.664	249	20.807	46.01%	47.69%
barred sand bass	148	24.39	72	10.075	191	29.429	248	33.448	51.44%	55.29%
walleye surfperch	51	1.177	105	2.435	121	2.533	183	3.487	37.39%	38.52%
shiner perch			76	1.729	4	0.15	337	12.175	0.96%	1.07%
rockpool blenny			93	0.451	1	0.01	264	0.728	0.28%	0.84%
deep body anchovy			67	0.786			107	1.194	0.00%	0.00%
Totals for Top 15 species	8482	859.35	12916	506.70	14198	982.37	38807	1357.11	30.48%	49.70%
Totals for all 80 species	8796	1111.45	13307	575.55	14491	1324.76	39457	1441.12	30.62%	54.71%

Of the 15 species of fish most commonly found in fish chase samples, the percent returned by weight ranged from 0% for deep body anchovy to 93.6% for spotfin croaker. Overall, 54.7% of the fish biomass that would have succumbed during the heat treatment was successfully removed prior to the heat treatment. A total of 23,287 fish weighing 2,436.2 kgs were released during fish chase. In 2009 the fish chase released an amount of fish equal to 4.13% of the total estimated impingement (Figure 4-1).

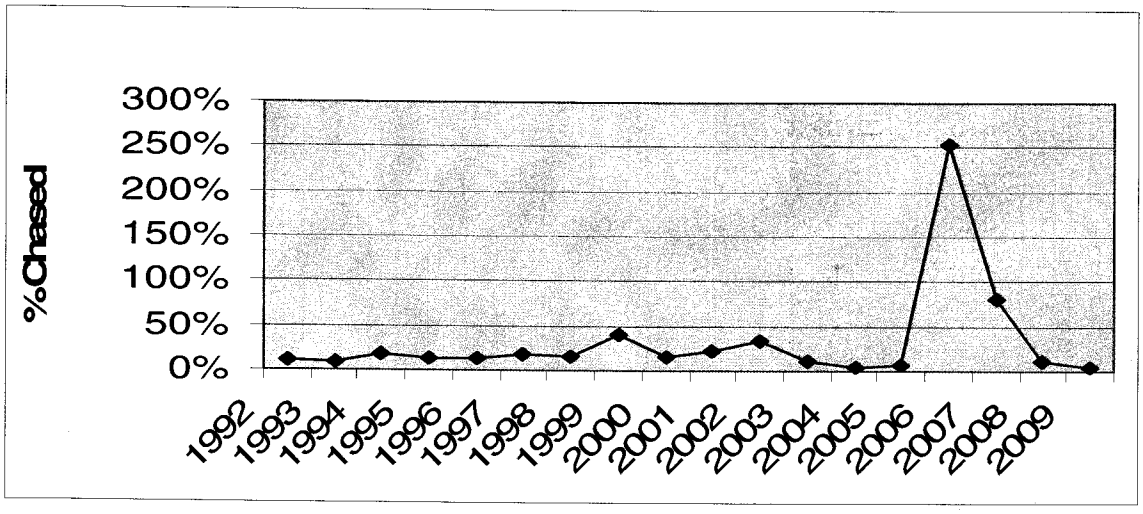


Figure 4-1. Percent of Total Biomass Returned by Fish Chase

Fish Return System Operation

The SONGS fish return system (FRS) is normally operated twice per day by station operators. It is a routine part of station operations that is logged on daily status sheets (Form SO123-0-10) (M. J. Johnson, Personal Communication). A summary of exceptions to daily operability of the fish return system in 2009 is detailed in Table 4-9.

Eleven years of data were collected from 1984 through 1994 to characterize the return efficiency of the fish return system. In 1999, an additional special study was conducted of the system and another one-year study was begun beginning in March 2006 as part of a program of data collection for a 316(b) demonstration. No fish return data was collected in 2009. A summary of data on the return efficiency of the FRS during all the studies is presented in Table 4-10. Return efficiency is the percent of fish returned to the fish return sluiceway during normal operation compared to the number of fish impinged and does not include fish returned during the fish chase operation.

Table 4-9. Operating status of the Fish Return System in 2009

Unit	Total days FRS Out of Service in 2009	Reason FRS was Out of Service.	% System Availability in 2009
2	0	NA	100%
3	14	Replaced failed relay and chain pin	96%

Table 4-10 Fish Biomass Return Efficiency
1984-1994, 1999, 2006 and 2007.

Year	Unit 2 % Returned	Unit 3 % Returned
1984	96.5	95.4
1985	88.3	60.1
1986	75	69.9
1987	65	67.8
1988	80	68.5
1989	41.6	58.4
1990	51.5	36.6
1991	75.4	66.3
1992	74.4	59.3
1993	83	78
1994	87.7	78.4
1999	72.4	68.22
2006	92.7	93.0
2007	71.6	64.7
Average	75.4	68.9

LENGTH FREQUENCY ANALYSIS

Figures 4-2 through 4-5 present length-frequency distributions of queenfish, northern anchovy, white croaker and Pacific sardine collected in-plant at Units 2 and 3 during 2009. These species were selected either because of their predominance in the catch (e.g., Pacific sardine, queenfish and northern anchovy) or because of their interest to resource managers (e.g., white croaker). Length data for all other species is provided in the 2009 data report and includes all length data collected in normal operation and heat treatment samples.

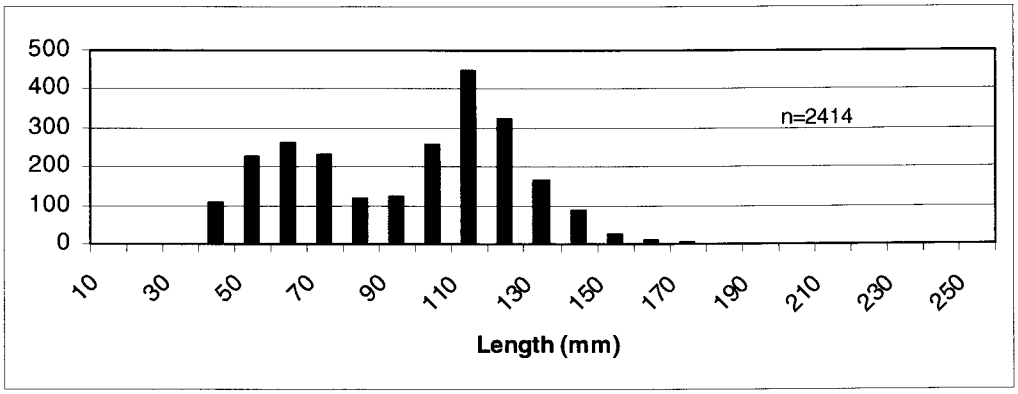


Figure 4-2. Queenfish lengths.

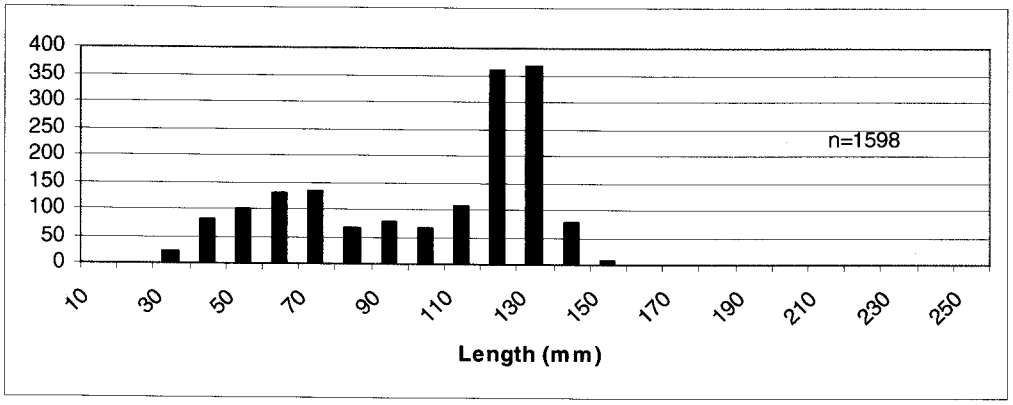


Figure 4-3. Northern anchovy lengths.

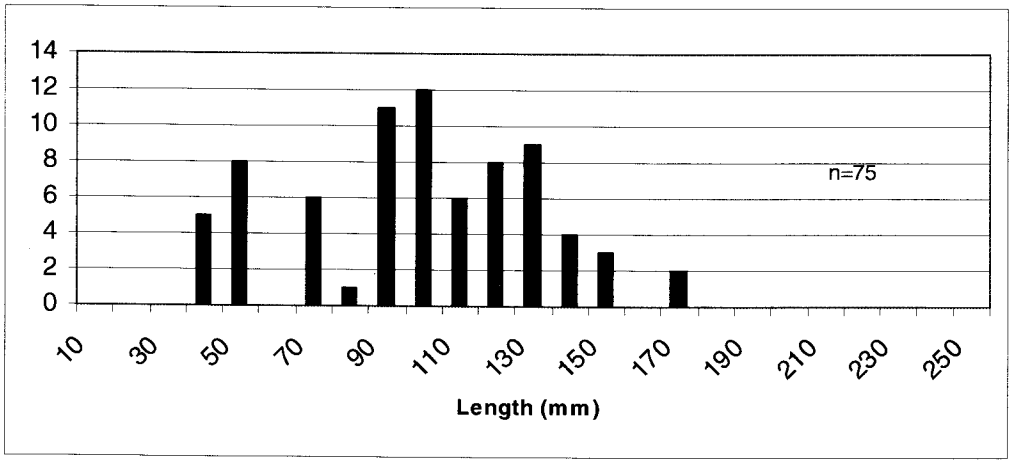


Figure 4-4. White croaker lengths.

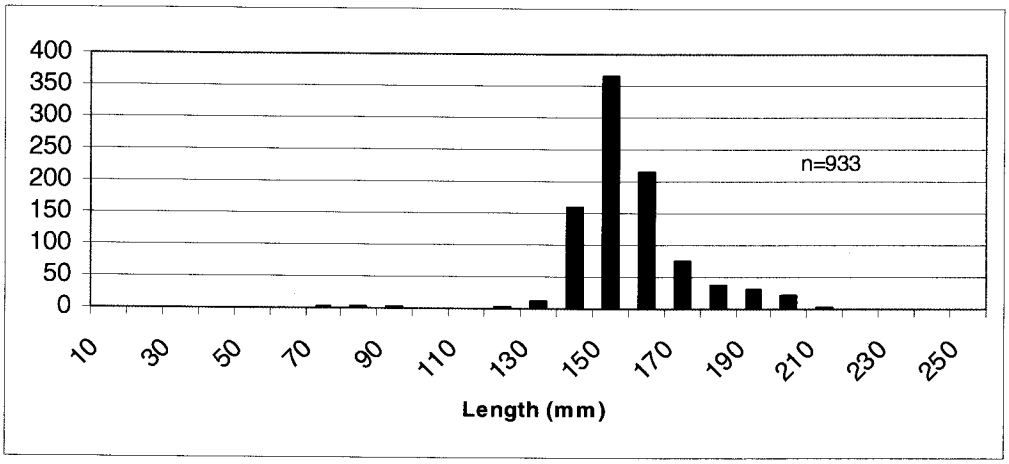


Figure 4-5. Pacific sardine lengths.

Queenfish: Queenfish lengths ranged from 40 to 170 mm. The length distribution is distinctly bimodal and represents two predominant modes at 70 and 110 mm representing mostly Age 0 and Age 1 individuals. These are the same modes seen each year since 2001. The range of lengths collected in 2009 also includes larger individuals representing weaker modes at Age 2 and above. The annual abundance of queenfish has fluctuated greatly from year to year with an apparent relationship with ENSO (El Niño/La Niña) events. Though abundance has remained generally strong during both warm and cool water periods, there were marked declines during the strong warm-water ENSO events of 1982-83, 1987 and 1997-98. In 1999 and 2000, cold water years, queenfish abundance was approximately double that of 1998. In 2009, queenfish were the second most numerous fish at both Units 2 and 3, after Pacific sardines, and were second in biomass at Unit 3 and third in biomass at Unit 2 following Pacific sardine and northern anchovy. Overall, queenfish numbers and biomass were greatly reduced from those seen in 2008.

Northern anchovy: In 2009, as in previous years, northern anchovy lengths ranged mostly from 30 to 150 mm throughout the year. Length modes likely follow the usual pattern of approximately 50, 90, 120 and 150 mm, but are superimposed and difficult to determine. The 2009 lengths differ from 2008 in that the young of the year (YOY) cohort is weaker while the older 120 mm cohort is stronger than in 2008. The smaller size class (around 50 mm) correlates to an age of 1.5 to 2.5 months (Sakagawa and Kimura 1976). Annual northern anchovy impingement biomass since 1989 has ranged from 73.07 kgs. (1998) to 35,714 kgs. (2005). Average annual impingement is 5,269 kg. Northern anchovy biomass in 2009 was 1,213.4 kg. (Units 2 and 3 combined.) This is nearly double the 2008 biomass, but much lower than the 19-year average. Though usually abundant, the northern anchovy biomass fluctuates greatly. This may be a result of global changes such as El Niño/La Niña conditions or just the patchiness of their distribution along the coast. In 2009, northern anchovies accounted for 3.14% and 7.89% of the total number of fish impinged at Units 2 and 3, respectively, and only 1.44% and 2.88%, respectively, of the biomass. Northern anchovy abundance has been low since 2005.

White croaker: In 2009 the primary length modes for white croaker were approximately 50, 100 and 130 mm. As in previous years, most were less than 150 mm, and therefore, immature. Unlike queenfish, whose abundance has fluctuated from year to year but has not shown any long-term decline, white croaker abundance over the same period exhibited an overall downward trend, with occasional noteworthy increases, such as seen in 1999 and 2000, likely related to episodes of cooler water temperatures. In 2009, white croaker numbers remained similar to 2007 and 2008 with an increase to 2,926 individuals, but biomass decreased to 29.49 kgs.

Pacific sardines: As in 2006, 2007 and 2008, there were two distinct length modes in 2009, one at 70 mm and one at 160 mm. As in 2008 the majority of fish in 2009 were in the larger length mode. Following the extremely high Pacific sardine catches of years 2004 and 2005, numbers fell precipitously in 2006 and continued at a low level in 2007 and 2008. However, Pacific sardine abundance greatly increased in 2009 due to high normal operation samples at both Unit 2 and Unit 3 in May 2009 (see Figure 4-7). Pacific sardines ranked first in numeric abundance at both Units 2 and 3, and also ranked first in biomass at both units in 2009. Unit 2 had an estimated 1,035,835 individuals weighing 31,944 kg., while Unit 3 had 550,244 individuals weighing 19,974 kg.

SEX COMPOSITION

Sex ratios of fish impinged at Units 2 and 3 are summarized in Table 4-12. As observed in past years, females frequently outnumbered males for many of the species studied. This is especially true of some of the perches, white croaker, and queenfish. This may be due to increased vulnerability to impingement of gravid females, especially the embiotocids that may have impaired swimming ability. These characteristics are consistent with data from previous years.

Table 4-11. Count by Sex of fish captured at SONGS in 2009

Common Name	Gender		%
	Female	Male	Female
barred sand bass	62	40	60.78%
barred surfperch	1	0	100.00%
black croaker	17	13	56.67%
black perch	13	13	50.00%
California butterfly ray	3	0	100.00%
California electric ray	5	1	83.33%
California halibut	2	1	66.67%
chub mackerel	1	0	100.00%
dwarf perch	14	1	93.33%
horn shark	1	1	50.00%
kelp perch	8	3	72.73%
kelpbass	6	5	54.55%
northern anchovy	239	135	63.90%
Pacific pompano	27	27	50.00%
Pacific sardine	205	146	58.40%
queenfish	329	259	55.95%
rock wrasse	20	11	64.52%
round stingray	9	3	75.00%
rubberlip seaperch	1	0	100.00%
sargo	76	77	49.67%
shiner perch	117	64	64.64%
shovelnose guitarfish	4	6	40.00%
spotfin croaker	1	41	2.38%
spotted sand bass	1	0	100.00%
walleye surfperch	102	109	48.34%
white croaker	14	7	66.67%
white seaperch	21	2	91.30%
yellowfin croaker	86	122	41.35%

TOTAL IMPINGEMENT

The total impingement fish loss for 2009 is the sum of the estimated annual impingement loss during normal operation plus fish impinged during heat treatment. Estimated annual impingement for Unit 2 in 2009, for all species combined, was 1,137,642 fish weighing 33,720 kilograms. Annual impingement at Unit 3 was 926,875 fish weighing 25,257 kilograms (Table 4-13).

Table 4-12. Total number and weight of fish caught at San Onofre Units 2 & 3 in 2009

Unit	Normal Operation Impingement Total	Heat Treatment Total	Total Fish Impingement
2 (Count)	1,124,335	13,307	1,137,642
2 (Kilograms)	33,145	576	33,720
3 (Count)	887,418	39,457	926,875
3 (Kilograms)	23,816	1,441	25,257

The estimated total fish impingement biomass for SONGS in 2009 was 58,978 kgs. (Figure 4-6). This is more than twice the 2008 total (23,234 kgs.). While 2005 had the highest estimated impingement ever recorded, 2006 and 2007 were among the lowest levels of impingement, and 2008 was close to the historical average. The high impingement numbers in 2009 resulted from two quarterly normal operation samples (one at Unit 2 and one at Unit 3) taken in May 2009. The total weight for the three most abundant species impinged is illustrated in Figure 4-7.

Figure 4-6. SONGS Impingement 1983 to 2009.

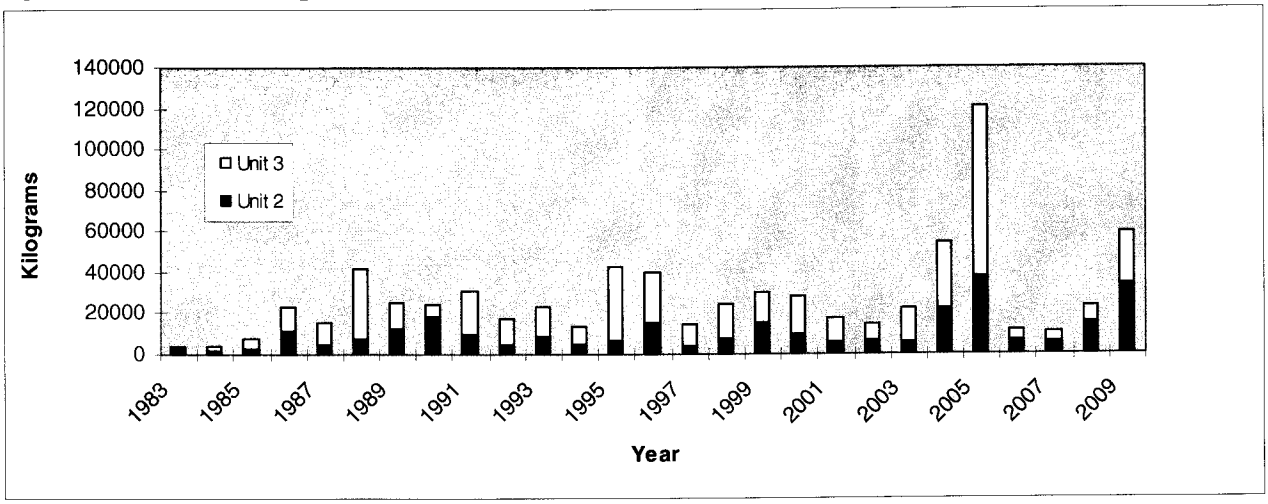
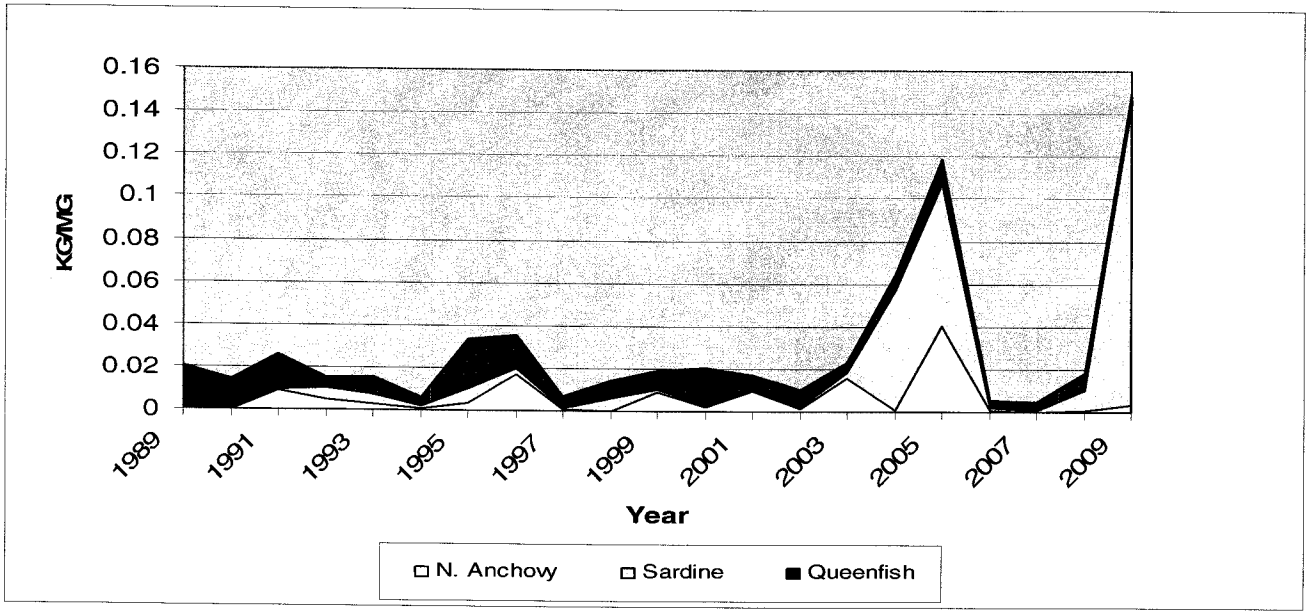


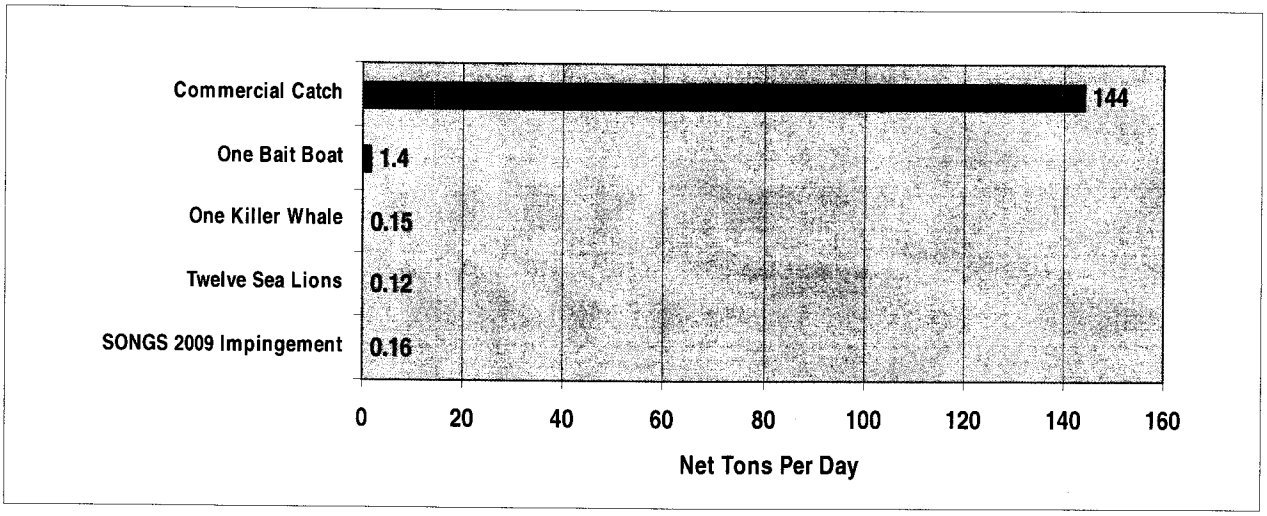
Figure 4-7. Kilograms of Select Species per Million Gallons of Sea Water.



COMPARISON TO OTHER SOURCES OF FISH LOSS

This report provides an estimate of fish loss due to impingement resulting from the use of seawater as a source of cooling water for the San Onofre Nuclear Generating Station. In order to put these losses in perspective, it may be useful to compare the impingement losses with other losses routinely experienced by Southern California fish populations. Figure 4-8 presents a variety of stresses on local fish populations and their relative magnitude in relation to SONGS impingement.

Figure 4-8. Comparison of Daily Losses



Data source: [1] California Living Marine Resources, p. 57, CDFG, 2001. So. Cal coastal pelagics only. [2]C. Cooney, Cal F&G, pers. com.; [3-4] "Marine Mammals of California" by A.E. Daugherty, 1979; [5]2009 Songs Annual Analysis Report.

SUMMARY

IMPINGEMENT

Overall, the combined weight of fish impinged at San Onofre in 2009 (58,978 kgs) was 215% of the 27-year average of 27,490 kgs. Unit 2 impingement biomass in 2009 was 341% of the 27-year average for Unit 2 while Unit 3 impingement was 154% of the 27-year average. The larger than average impingement estimates are a result of a high number of Pacific sardines occurring in a one-day normal operation sample in May 2009.

Unit 1

San Onofre Unit 1 was taken out of service in 1992. It did not operate in 2008, and is not considered in this report.

Unit 2

A total of 58 species of fish were counted and weighed at Unit 2 in 2009. When weighted by the total amount of seawater used by Unit 2 in 2009, the estimated fish impingement was 1,137,642 individuals weighing 33,720 kilograms. The top 15 species accounted for 99.77% of the total number and 99.68% of the total weight. Pacific sardines were the most numerous species contributing 91.05% of the total number of fish. Pacific sardine also contributed the most weight at Unit 2, with 94.73% of the total biomass.

Unit 3

A total of 68 species of fish were counted and weighed at Unit 3 in 2009. When weighted by the total amount of seawater used by Unit 3 in 2009, the estimated fish impingement was 926,875 individuals weighing 25,255 kilograms. The top 15 species accounted for 99% of the total number and 98.92% of the total weight. Pacific sardines were the most numerous species contributing 59.37% of the total number of fish. Pacific sardines also contributed the greatest weight with 79.09% of the total biomass.

FISH CHASE

A special procedure called a "fish chase" has been developed at San Onofre to cause fish to leave the circulating water system before heat treatments begin. In 2009, a total of 2,016.67 kgs of fish were impinged during heat treatment operations at SONGS. At the same time, as a result of the "Fish Chase" procedure, 2,436.20 kgs of fish were successfully released back to the ocean prior to the heat treatments. The percentage of fish released varied among the heat treatments, but averaged 54.7% for the year.

* * * *

There is no evidence that fish impingement at SONGS has significantly impacted the maintenance of a balanced, indigenous fish population in the receiving water, or impaired any beneficial uses dependent on the fisheries resources.

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APPENDIX A

List of Heat Treatment, Fish Chase and Normal Operation Samples at SONGS Units 2 and 3 in 2009.

Appendix A. Fish Samples Taken in 2009

Unit	Date	Sample Type	Fish Nos.	Biomass (Kgs.)
San Onofre 2	2/21/2009	Fish Chase	1,408	178.26
San Onofre 2	2/21/2009	Heat Treatment	1,332	74.639
San Onofre 2	3/14/2009	Fish Chase	209	8.5
San Onofre 2	3/14/2009	Heat Treatment	328	58.646
San Onofre 2	3/24/2009	Normal Operation	351	7.816
San Onofre 2	4/25/2009	Fish Chase	295	44.26
San Onofre 2	4/25/2009	Heat Treatment	1,366	36.387
San Onofre 2	5/12/2009	Normal Operation	11,652	354.082
San Onofre 2	6/6/2009	Fish Chase	2,428	223.12
San Onofre 2	6/6/2009	Heat Treatment	6,441	190.1
San Onofre 2	7/19/2009	Fish Chase	1,339	397.768
San Onofre 2	7/19/2009	Heat Treatment	1,587	149.292
San Onofre 2	9/5/2009	Fish Chase	2,061	219.186
San Onofre 2	9/5/2009	Heat Treatment	1,268	37.292
San Onofre 2	9/9/2009	Fish Chase	336	30.481
San Onofre 2	9/9/2009	Heat Treatment	752	23.602
San Onofre 2	9/13/2009	Fish Chase	720	9.87
San Onofre 2	9/13/2009	Heat Treatment	233	5.59
San Onofre 2	9/15/2009	Normal Operation	421	1.733
San Onofre 2	12/22/2009	Normal Operation	47	5.211
San Onofre 3	2/14/2009	Fish Chase	1,508	85.725
San Onofre 3	2/14/2009	Heat Treatment	3,804	89.1255
San Onofre 3	3/24/2009	Normal Operation	1,150	32.71
San Onofre 3	4/10/2009	Fish Chase	2,204	45.107
San Onofre 3	4/10/2009	Heat Treatment	10,344	210.873
San Onofre 3	5/12/2009	Normal Operation	6,086	214.954
San Onofre 3	5/23/2009	Fish Chase	2,773	206.62
San Onofre 3	5/23/2009	Heat Treatment	12,638	313.368
San Onofre 3	5/25/2009	Fish Chase	653	32.14
San Onofre 3	5/25/2009	Heat Treatment	1,156	43.228
San Onofre 3	7/3/2009	Fish Chase	1,655	117.384
San Onofre 3	7/3/2009	Heat Treatment	2,281	130.681
San Onofre 3	8/15/2009	Fish Chase	1,500	421.985
San Onofre 3	8/15/2009	Heat Treatment	2,009	339.309
San Onofre 3	9/15/2009	Normal Operation	803	4.518
San Onofre 3	9/24/2009	Fish Chase	1,575	194.632
San Onofre 3	9/24/2009	Heat Treatment	3,981	202.669
San Onofre 3	11/19/2009	Fish Chase	2,623	221.166
San Onofre 3	11/19/2009	Heat Treatment	3,244	111.869
San Onofre 3	12/22/2009	Normal Operation	1,698	9.737

APPENDIX B.

Estimated Monthly Number of Fish Impinged at SONGS Unit 2 in 2009.

Appendix B. Estimated Monthly Number of Fish Impinged at SONGS Unit 2 in 2009.

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Pacific sardine	631	944	1274	340322	351664	340669	93	93	100	0	21	23	1035835
queenfish	2903	4283	5784	1042	682	1276	12018	11005	11214	4	301	315	50828
northern anchovy	458	827	900	8775	8308	12224	1147	1147	1130	6	408	428	35757
plainfin midshipman	805	1117	1582	0	0	0	0	0	0	0	0	0	3504
jack mackerel	16	547	91	130	124	952	237	0	451	0	0	0	2548
white croaker	79	110	155	6	0	3	218	217	199	0	0	0	987
topsmelt	63	175	144	120	124	190	38	31	68	0	0	0	953
kelp pipefish	95	135	186	120	124	120	31	31	28	0	21	23	914
deep body anchovy	0	41	0	0	0	0	93	93	109	3	193	203	735
giant kelpfish	63	91	126	64	62	61	63	62	60	0	0	0	651
salema	47	72	104	70	0	187	40	31	63	0	0	0	614
slough anchovy	0	10	1	0	0	0	186	186	177	0	21	23	604
California scorpionfish	16	30	35	70	62	73	34	31	30	0	0	0	380
jacksmelt	16	72	113	41	0	43	31	31	30	0	0	0	376
Pacific pompano	79	111	155	3	0	2	0	0	5	0	0	0	355
speckled sanddab	79	110	155	1	0	0	0	0	0	0	0	0	345
walleye surfperch	32	52	65	11	0	5	19	0	59	0	0	0	242
white seaperch	0	1	1	61	62	74	11	0	7	0	0	0	217
shiner perch	32	44	62	18	0	24	15	0	19	0	0	0	213
yellowfin croaker	0	2	0	10	0	1	171	0	3	0	0	0	187
rockpool blenny	0	16	14	8	0	19	34	31	61	0	0	0	183
California butterfly ray	16	22	31	1	0	0	31	31	28	0	0	0	159
Pacific barracuda	32	49	63	3	0	0	0	0	0	0	0	0	146
black perch	16	22	32	5	0	21	8	0	12	0	0	0	116
chub mackerel	0	3	1	2	0	5	31	31	29	0	0	0	102
senorita	16	23	32	1	0	8	7	0	7	0	0	0	94
California corbina	16	23	31	2	0	0	0	0	1	0	0	0	73
barred sand bass	0	26	1	22	0	10	3	0	10	0	0	0	72
bocaccio	16	22	31	1	0	1	1	0	0	0	0	0	72
specklefin midshipman	16	22	31	0	0	1	0	0	1	0	0	0	71
sargo	0	2	4	4	0	7	37	0	15	0	0	0	69
California electric ray	0	0	0	0	0	0	0	0	0	0	21	23	44
California halibut	0	0	0	0	0	0	0	0	0	0	21	23	44
black croaker	0	1	2	0	0	0	2	0	14	0	0	0	19
rock wrasse	0	0	0	1	0	1	14	0	2	0	0	0	18
cabezon	0	1	0	7	0	3	6	0	0	0	0	0	17
dwarf perch	0	0	0	0	0	0	0	0	10	0	0	0	10
shovelnose guitarfish	0	0	0	1	0	0	9	0	0	0	0	0	10
kelpbass	0	0	0	0	0	1	0	0	7	0	0	0	8
spotfin croaker	0	0	0	2	0	3	0	0	3	0	0	0	8
spotted kelpfish	0	0	0	0	0	1	6	0	1	0	0	0	8
grass rockfish	0	0	0	0	0	7	0	0	0	0	0	0	7
basketweave cusk-eel	0	5	0	0	0	0	1	0	0	0	0	0	6
blacksmith	0	0	0	0	0	1	1	0	4	0	0	0	6
kelp perch	0	0	0	0	0	1	1	0	4	0	0	0	6
vermilion rockfish	0	3	1	0	0	0	0	0	0	0	0	0	4

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round stingray	0	0	0	0	0	3	0	0	0	0	0	0	3
rubberlip seaperch	0	0	0	0	0	2	0	0	1	0	0	0	3
white seabass	0	0	0	1	0	0	0	0	2	0	0	0	3
brown rockfish	0	1	0	0	0	0	0	0	1	0	0	0	2
California grunion	0	0	0	1	0	0	0	0	1	0	0	0	2
horn shark	0	0	0	0	0	1	0	0	1	0	0	0	2
pile perch	0	0	0	0	0	0	1	0	1	0	0	0	2
spotted turbot	0	1	1	0	0	0	0	0	0	0	0	0	2
barcheek pipefish	0	0	0	0	0	0	0	0	1	0	0	0	1
finescale triggerfish	0	0	0	0	0	1	0	0	0	0	0	0	1
giant seabass	0	0	1	0	0	0	0	0	0	0	0	0	1
Pacific staghorn sculpin	0	1	0	0	0	0	0	0	0	0	0	0	1
	5539	9015	11209	350926	361212	356001	14638	13051	13967	14	1010	1058	1137642

APPENDIX C.

Estimated Monthly Catch in Kilograms of Fish at SONGS Unit 2 in 2009.

Appendix C. Estimated Monthly Catch in Kilograms of Fish at SONGS Unit 2 in 2009.

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Pacific sardine	24.22	37.10	49.74	10485.15	10834.56	10502.10	3.13	3.13	3.67	0.01	0.82	0.86	31944.48
northern anchovy	2.48	5.81	4.88	129.05	120.28	193.38	0.50	0.50	0.62	0.20	14.02	14.68	486.39
queenfish	40.44	76.70	80.42	12.78	6.57	20.15	45.34	30.75	39.93	0.02	1.14	1.19	355.43
California electric ray	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.35	94.60	99.09	195.04
jack mackerel	0.93	32.35	5.48	5.89	5.64	62.06	16.94	0.00	38.55	0.00	0.00	0.00	167.83
plainfin midshipman	34.31	47.63	67.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	149.39
yellowfin croaker	0.00	0.11	0.00	1.20	0.00	0.12	106.90	0.00	0.23	0.00	0.00	0.00	108.56
giant seabass	0.00	0.00	42.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.00
topsmelt	1.99	6.91	4.65	5.82	6.01	7.72	1.07	0.81	2.45	0.00	0.00	0.00	37.43
California butterfly ray	3.36	4.66	6.60	0.13	0.00	0.00	6.39	6.39	5.73	0.00	0.00	0.00	33.26
jacksmelt	0.73	5.91	8.20	3.03	0.00	5.00	2.14	2.14	2.09	0.00	0.00	0.00	29.23
salema	1.74	2.56	3.73	1.90	0.00	6.43	0.44	0.06	2.13	0.00	0.00	0.00	19.00
chub mackerel	0.00	0.35	0.11	0.07	0.00	0.59	5.15	5.15	4.79	0.00	0.00	0.00	16.20
California scorpionfish	1.37	3.15	3.34	0.72	0.12	0.61	1.47	1.40	1.53	0.00	0.00	0.00	13.71
kelp pipefish	0.82	1.17	1.61	2.28	2.36	2.28	0.99	0.99	0.89	0.00	0.06	0.07	13.53
Pacific pompano	2.89	4.09	5.67	0.18	0.00	0.06	0.00	0.00	0.26	0.00	0.00	0.00	13.14
barred sand bass	0.00	4.05	0.24	2.23	0.00	1.87	0.30	0.00	1.38	0.00	0.00	0.00	10.08
sargo	0.00	0.15	0.25	0.32	0.00	0.70	6.00	0.00	2.06	0.00	0.00	0.00	9.49
white croaker	1.37	1.92	2.70	0.14	0.00	0.05	0.40	0.34	0.44	0.00	0.00	0.00	7.37
walleye surfperch	1.09	1.79	2.24	0.16	0.00	0.09	0.31	0.00	1.50	0.00	0.00	0.00	7.17
California corbina	1.55	2.19	3.04	0.15	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	7.00
shiner perch	0.88	1.23	1.74	0.67	0.00	0.40	0.41	0.00	0.25	0.00	0.00	0.00	5.57
giant kelpfish	0.52	0.89	1.17	0.82	0.62	0.66	0.26	0.22	0.35	0.00	0.00	0.00	5.50
shovelnose guitarfish	0.00	0.00	0.00	4.90	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	5.38
deep body anchovy	0.00	0.45	0.00	0.00	0.00	0.00	0.74	0.74	1.00	0.01	0.97	1.01	4.94
speckled sanddab	1.12	1.57	2.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.90
Pacific barracuda	0.90	1.36	1.81	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.15
horn shark	0.00	0.00	0.00	0.00	0.00	2.25	0.00	0.00	0.53	0.00	0.00	0.00	2.78
black perch	0.08	0.11	0.21	0.03	0.00	1.10	0.39	0.00	0.82	0.00	0.00	0.00	2.73
rockpool blenny	0.00	0.13	0.07	0.04	0.00	0.12	0.68	0.65	0.65	0.00	0.00	0.00	2.34
senorita	0.44	0.65	0.87	0.07	0.00	0.08	0.08	0.00	0.12	0.00	0.00	0.00	2.32
white seaperch	0.00	0.04	0.03	0.41	0.37	0.48	0.16	0.00	0.13	0.00	0.00	0.00	1.62
rock wrasse	0.00	0.00	0.00	0.01	0.00	0.06	1.40	0.00	0.12	0.00	0.00	0.00	1.59
slough anchovy	0.00	0.02	0.00	0.00	0.00	0.00	0.47	0.47	0.46	0.00	0.06	0.07	1.55
spotfin croaker	0.00	0.00	0.00	0.13	0.00	1.19	0.00	0.00	0.22	0.00	0.00	0.00	1.54
black croaker	0.00	0.04	0.29	0.00	0.00	0.00	0.18	0.00	0.85	0.00	0.00	0.00	1.36
round stingray	0.00	0.00	0.00	0.00	0.00	1.34	0.00	0.00	0.00	0.00	0.00	0.00	1.34
California halibut	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.37	0.38	0.75
finescale triggerfish	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.71
specklefin midshipman	0.06	0.09	0.12	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.70
white seabass	0.00	0.00	0.00	0.43	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.47
kelpbass	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.40	0.00	0.00	0.00	0.41
grass rockfish	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.38
brown rockfish	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.32
bocaccio	0.05	0.07	0.09	0.01	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.24
blacksmith	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.00	0.11	0.00	0.00	0.00	0.18

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basketweave cusk-eel	0.00	0.15	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.17
cabezon	0.00	0.00	0.00	0.03	0.00	0.05	0.07	0.00	0.00	0.00	0.00	0.00	0.16
dwarf perch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.14
kelp perch	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.08	0.00	0.00	0.00	0.11
pile perch	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.02	0.00	0.00	0.00	0.11
spotted kelpfish	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.00	0.01	0.00	0.00	0.00	0.09
Pacific staghorn sculpin	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
rubberlip seaperch	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.03
California grunion	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.03
spotted turbot	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
vermilion rockfish	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
barcheek pipefish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	123.30	245.73	300.94	10658.85	10976.54	10812.56	203.02	53.72	114.71	1.60	112.04	117.36	33720.39

APPENDIX D.

Estimated Monthly Number of Fish Impinged at SONGS Unit 3 in 2009.

Appendix D. Estimated Monthly Number of Fish Impinged at SONGS Unit 3 in 2009

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Pacific sardine	2294	2833	2294	176478	183706	176460	157	166	151	1922	1861	1922	550244
queenfish	23064	22765	23064	1478	2148	1320	19161	19657	20243	40486	40985	40486	254857
northern anchovy	4061	4209	4061	13475	13857	4020	2978	3045	2901	6882	6727	6882	73098
plainfin midshipman	3689	3333	3689	106	64	60	0	1	0	0	0	0	10942
deep body anchovy	31	45	31	7	0	0	713	713	732	1736	1728	1736	7472
jack mackerel	0	197	0	41	1339	0	1568	203	501	0	174	0	4023
slough anchovy	0	2	0	0	0	0	248	248	241	744	724	744	2951
Pacific pompano	651	603	651	2	0	0	32	32	34	0	2	0	2007
white croaker	341	310	341	7	12	0	186	186	182	124	126	124	1939
salema	186	174	186	225	85	0	102	288	185	0	450	0	1881
giant kelpfish	124	115	124	120	127	120	250	249	243	124	126	124	1846
sargo	0	0	0	1	0	0	99	394	1004	62	144	62	1766
speckled sanddab	434	396	434	120	124	120	0	0	0	0	1	0	1629
white seabass	0	0	0	0	0	0	496	500	488	0	2	0	1486
topsmelt	0	107	0	148	258	120	328	77	83	62	230	62	1475
walleye surfperch	31	36	31	71	71	60	227	237	277	62	118	62	1283
yellowfin croaker	0	0	0	0	0	0	192	406	326	0	50	0	974
kelp pipefish	93	94	93	0	1	0	0	2	1	186	181	186	837
California scorpionfish	124	115	124	22	14	0	70	64	65	62	66	62	788
rockpool blenny	31	28	31	114	69	60	6	0	10	0	187	0	536
barred sand bass	0	32	0	59	4	0	47	75	95	62	88	62	524
Pacific barracuda	62	68	62	2	3	0	31	33	30	62	61	62	476
jacksmelt	62	128	62	145	16	0	2	6	3	0	5	0	429
cheekspot goby	0	0	0	120	124	120	0	0	0	0	0	0	364
shiner perch	0	0	0	21	266	0	21	14	12	0	3	0	337
black perch	31	28	31	60	68	60	2	2	1	0	4	0	287
California corbina	0	1	0	0	1	0	93	99	91	0	0	0	285
bat ray	93	84	93	0	0	0	0	0	0	0	0	0	270
senorita	0	1	0	60	63	60	4	3	0	0	2	0	193
specklefin midshipman	62	56	62	1	0	0	0	0	0	0	12	0	193
basketweave cusk-eel	62	60	62	3	0	0	0	0	0	0	0	0	187
California lizardfish	0	1	0	0	1	0	0	0	0	62	60	62	186
black croaker	0	0	0	1	1	0	31	31	37	0	13	0	114
chub mackerel	31	33	31	3	4	0	0	0	3	0	0	0	105
California grunion	0	0	0	5	1	0	31	31	30	0	3	0	101
California halibut	0	0	0	0	0	0	31	33	30	0	7	0	101
spotted turbot	31	33	31	0	1	0	0	0	0	0	0	0	96
California electric ray	31	29	31	0	0	0	0	0	0	0	3	0	94
bocaccio	31	28	31	0	0	0	2	0	0	0	0	0	92
California tonguefish	0	0	0	0	0	0	31	31	30	0	0	0	92
kelpbass	0	1	0	0	0	0	1	2	18	0	31	0	53
mussel blenny	0	44	0	0	0	0	0	0	0	0	0	0	44
spotfin croaker	0	0	0	0	1	0	3	25	8	0	2	0	39

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Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
white seaperch	0	4	0	0	16	0	3	7	5	0	3	0	38
cabezon	0	7	0	20	7	0	2	0	0	0	1	0	37
rock wrasse	0	0	0	2	0	0	7	12	4	0	2	0	27
kelp perch	0	0	0	0	0	0	2	7	0	0	0	0	9
round stingray	0	0	0	1	0	0	0	8	0	0	0	0	9
rubberlip seaperch	0	0	0	0	6	0	3	0	0	0	0	0	9
blacksmith	0	1	0	0	0	0	4	0	1	0	2	0	8
spotted kelpfish	0	0	0	0	1	0	5	0	1	0	0	0	7
brown rockfish	0	0	0	2	1	0	1	2	0	0	0	0	6
zebra perch	0	0	0	0	0	0	0	6	0	0	0	0	6
dwarf perch	0	0	0	0	0	0	0	5	0	0	0	0	5
calico rockfish	0	0	0	0	0	0	3	0	0	0	0	0	3
barred surfperch	0	0	0	1	0	0	0	1	0	0	0	0	2
vermilion rockfish	0	1	0	1	0	0	0	0	0	0	0	0	2
calico sculpin	0	0	0	0	0	0	0	0	1	0	0	0	1
California butterfly ray	0	1	0	0	0	0	0	0	0	0	0	0	1
Dover sole	0	0	0	0	0	0	0	0	1	0	0	0	1
garibaldi	0	0	0	0	0	0	0	0	1	0	0	0	1
hornyhead turbot	0	0	0	1	0	0	0	0	0	0	0	0	1
onespot fringehead	0	1	0	0	0	0	0	0	0	0	0	0	1
Pacific herring	0	0	0	1	0	0	0	0	0	0	0	0	1
painted greenling	0	0	0	0	0	0	0	0	1	0	0	0	1
shovelnose guitarfish	0	0	0	0	0	0	0	1	0	0	0	0	1
spotted sand bass	0	0	0	0	0	0	1	0	0	0	0	0	1
yellow snake eel	0	0	0	0	0	0	0	0	1	0	0	0	1
	35650	36004	35650	192924	202460	182580	27174	26902	28071	52638	54184	52638	926875

APPENDIX E.

Estimated Monthly Catch in Kilograms of Fish at SONGS Unit 3 in 2009.

APPENDIX E. Estimated Monthly Catch in Kilograms of Fish at SONGS Unit 3 in 2009.

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Pacific sardine	79.27	109.66	79.27	6353.1	6625.3	6352.2	5.42	5.78	5.20	120.90	117.04	120.90	19974.0
queenfish	365.18	345.15	365.18	21.68	35.49	16.80	105.26	111.62	107.62	145.70	149.84	145.70	1915.20
California electric ray	249.55	230.35	249.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.10	0.00	758.55
northern anchovy	48.70	47.28	48.70	216.03	229.09	59.76	8.06	8.20	7.88	17.86	17.59	17.86	727.00
plainfin midshipman	155.00	140.00	155.00	4.87	1.85	1.68	0.00	0.01	0.00	0.00	0.00	0.00	458.42
jack mackerel	0.00	10.75	0.00	2.23	84.01	0.00	104.72	29.85	40.60	0.00	15.35	0.00	287.51
sargo	0.00	0.00	0.00	0.02	0.00	0.00	1.39	158.96	95.23	0.19	14.10	0.19	270.07
yellowfin croaker	0.00	0.00	0.00	0.00	0.00	0.00	1.68	90.08	21.95	0.00	8.26	0.00	121.97
bat ray	41.01	37.04	41.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	119.07
salema	4.53	4.17	4.53	6.82	3.26	0.00	1.86	19.09	15.79	0.00	15.30	0.00	75.34
Pacific herring	25.48	23.02	25.48	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	74.01
California scorpionfish	14.04	12.83	14.04	6.95	0.33	0.00	0.97	0.51	0.93	0.93	2.30	0.93	54.77
deep body anchovy	0.28	0.42	0.28	0.00	0.00	0.00	7.69	7.69	7.97	9.49	9.67	9.49	52.97
topsmelt	0.00	3.53	0.00	5.63	9.43	4.38	10.79	2.21	2.26	1.49	9.04	1.49	50.24
giant kelpfish	5.12	4.73	5.12	6.97	6.97	6.60	1.47	1.43	1.54	1.12	1.47	1.12	43.63
barred sand bass	0.00	4.68	0.00	8.71	0.73	0.00	4.44	7.20	9.76	0.19	3.35	0.19	39.24
jacksmelt	5.64	10.20	5.64	12.36	1.81	0.00	0.17	0.67	0.23	0.00	0.47	0.00	37.19
white seabass	0.00	0.00	0.00	0.00	0.00	0.00	7.94	8.20	8.17	0.00	0.79	0.00	25.09
white croaker	6.23	5.73	6.23	1.35	0.47	0.00	0.28	0.28	0.30	0.40	0.46	0.40	22.13
walleye surfperch	1.30	1.42	1.30	0.77	0.58	0.24	3.08	3.45	2.98	0.81	2.31	0.81	19.04
speckled sanddab	2.79	2.55	2.79	2.16	2.23	2.16	0.00	0.00	0.00	0.00	0.00	0.00	14.69
spotfin croaker	0.00	0.00	0.00	0.00	0.25	0.00	1.10	7.95	3.52	0.00	0.40	0.00	13.22
shiner perch	0.00	0.00	0.00	0.83	10.67	0.00	0.34	0.15	0.14	0.00	0.05	0.00	12.18
Pacific barracuda	2.54	2.55	2.54	0.08	0.16	0.00	0.09	0.18	0.09	0.00	0.04	0.00	8.27
chub mackerel	1.89	2.44	1.89	0.22	0.51	0.00	0.00	0.00	0.35	0.00	0.00	0.00	7.30
slough anchovy	0.00	0.01	0.00	0.00	0.00	0.00	0.59	0.59	0.57	1.80	1.75	1.80	7.11
cheekspot goby	0.00	0.00	0.00	2.16	2.23	2.16	0.00	0.00	0.00	0.00	0.00	0.00	6.55
senorita	0.00	0.00	0.00	2.04	2.11	2.04	0.06	0.13	0.00	0.00	0.08	0.00	6.45
kelp pipefish	1.74	1.64	1.74	0.00	0.01	0.00	0.00	0.03	0.02	0.37	0.36	0.37	6.28
Pacific pompano	0.00	0.56	0.00	0.12	0.00	0.00	1.37	1.36	1.38	0.31	0.33	0.31	5.74
shovelnose guitarfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.20	0.00	0.00	0.00	0.00	5.20
basketweave cusk-eel	1.71	1.58	1.71	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.19
spotted turbot	1.09	1.01	1.09	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.20
round stingray	0.00	0.00	0.00	0.43	0.00	0.00	0.00	2.55	0.00	0.00	0.00	0.00	2.98
kelpbass	0.00	0.01	0.00	0.00	0.00	0.00	0.11	0.20	1.60	0.00	0.82	0.00	2.74
zebra perch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.60	0.00	0.00	0.00	0.00	2.60
rock wrasse	0.00	0.00	0.00	0.26	0.00	0.00	0.43	1.14	0.35	0.00	0.22	0.00	2.41
speckiefin midshipman	0.59	0.53	0.59	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	2.34
black croaker	0.00	0.00	0.00	0.19	0.11	0.00	0.06	0.06	0.48	0.00	1.43	0.00	2.33
black perch	0.22	0.20	0.22	0.30	0.46	0.30	0.06	0.09	0.04	0.00	0.40	0.00	2.27
rockpool blenny	0.06	0.06	0.06	0.66	0.36	0.30	0.03	0.00	0.03	0.00	0.26	0.00	1.82
California corbina	0.00	0.32	0.00	0.00	0.08	0.00	0.28	0.61	0.41	0.00	0.00	0.00	1.70
brown rockfish	0.00	0.00	0.00	1.44	0.14	0.00	0.01	0.06	0.00	0.00	0.00	0.00	1.65

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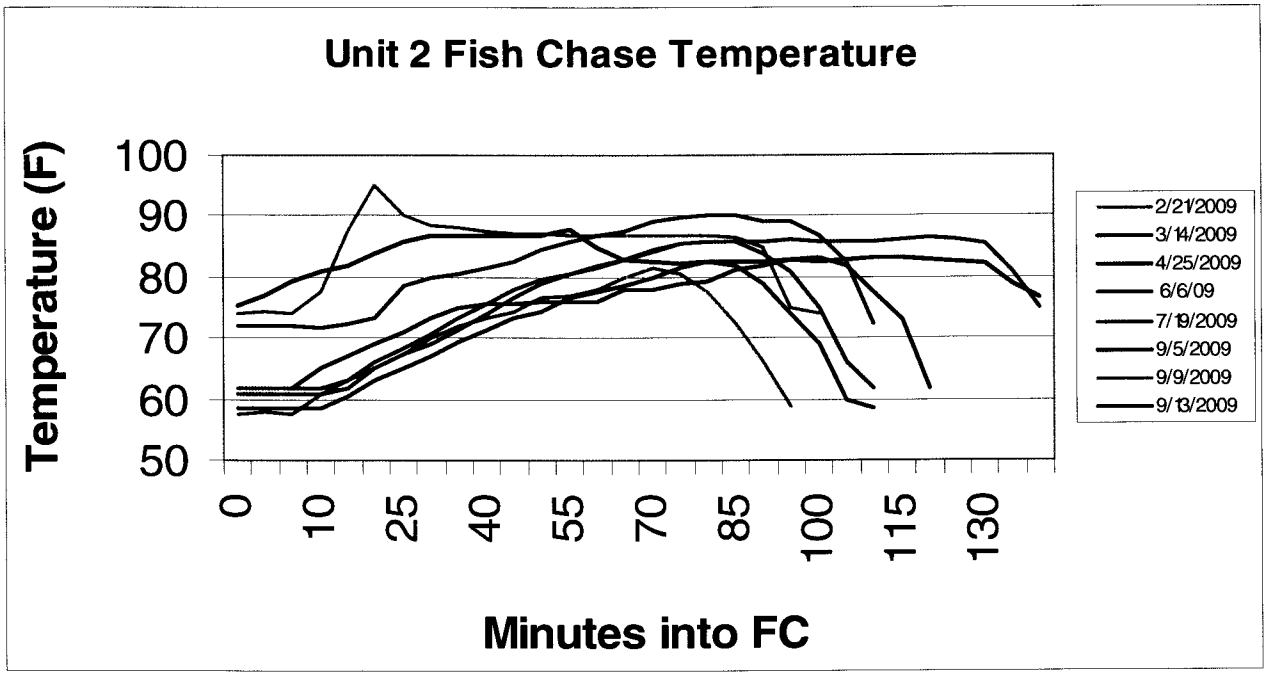
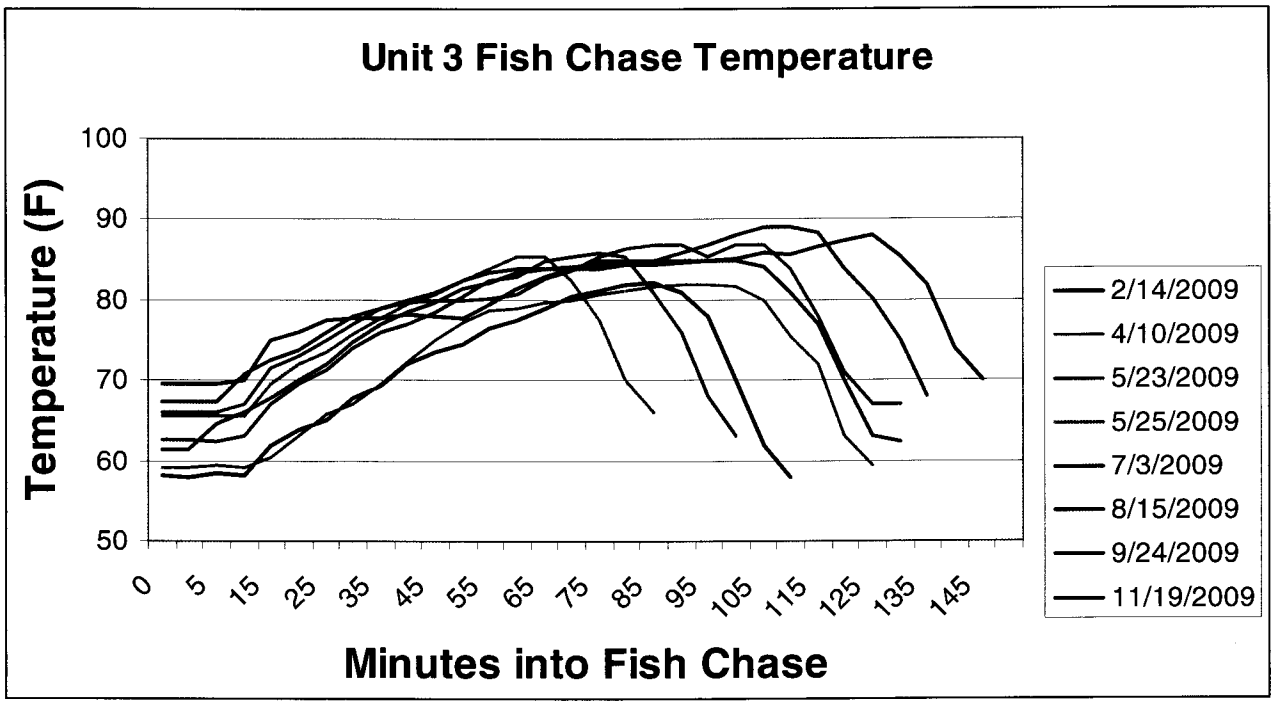
Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
California halibut	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.59	0.06	0.00	0.60	0.00	1.32
rubberlip seaperch	0.00	0.00	0.00	0.00	1.07	0.00	0.04	0.00	0.00	0.00	0.00	0.00	1.11
white seaperch	0.00	0.09	0.00	0.00	0.30	0.00	0.13	0.20	0.09	0.00	0.14	0.00	0.95
California lizardfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.30	0.31	0.93
cabezon	0.00	0.16	0.00	0.23	0.13	0.00	0.07	0.00	0.00	0.00	0.24	0.00	0.83
California grunion	0.00	0.00	0.00	0.07	0.01	0.00	0.12	0.12	0.12	0.00	0.05	0.00	0.50
spotted sand bass	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.28
yellow snake eel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.21
blacksmith	0.00	0.01	0.00	0.00	0.00	0.00	0.13	0.00	0.02	0.00	0.06	0.00	0.21
bocaccio	0.06	0.06	0.06	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.21
mussel blenny	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
garibaldi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.15
kelp perch	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.12	0.00	0.00	0.00	0.00	0.15
California butterfly ray	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
barred surfperch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.09
California tonguefish	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.00	0.00	0.00	0.09
painted greenling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.09
spotted kelpfish	0.00	0.00	0.00	0.00	0.01	0.00	0.06	0.00	0.01	0.00	0.00	0.00	0.08
dwarf perch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.07
calico rockfish	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02
hornyhead turbot	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
calico sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
vermilion rockfish	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Dover sole	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
onespot fringehead	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	1014.01	1005.01	1014.01	6659.49	7020.17	6448.62	270.74	476.77	338.21	301.85	403.98	301.85	25254.70

APPENDIX F.

Graphs of Temperature Curves for Fish Chases At SONGS Units 2 and 3 in 2009


Unit 2 Fish Chase Temperature
Temperature (F)
100
90
80
70
60
50
0
10
25
40
55
70
85
100
115
130
Minutes into FC
2/21/2009
3/14/2009
4/25/2009
6/6/09
7/19/2009
9/5/2009
9/9/2009
9/13/2009


Unit 3 Fish Chase Temperature
Temperature (F)
100
90
80
70
60
50
0
5
15
25
35
45
55
65
75
85
95
105
115
125
135
145
Minutes into Fish Chase
2/14/2009
4/10/2009
5/23/2009
5/25/2009
7/3/2009
8/15/2009
9/24/2009
11/19/2009

APPENDIX G.

Summary of Fish Released During Fish Chase Operations (By Species)

Appendix G. Summary of Fish Released During Fish Chase Operations (By Species)

Common Name	Unit 2 Fish Chase		Unit 2 Heat Treat		Unit 3 Fish Chase		Unit 3 Heat treat		% Returned	% Returned
	Number	Kgs	Number	Kgs	Number	Kgs	Number	Kgs	by Count	by Biomass
northern anchovy	725	2.091	5,212	92.19	3,341	41.66	19,858	327.5	13.96%	9.44%
queenfish	1,193	72.258	3,682	68.69	1,486	14.96	7,713	77.33	19.04%	37.39%
jack mackerel	3,028	212.42	2,115	147.2	3,785	305.2	4,023	287.5	52.61%	54.35%
Pacific sardine	257	12.93	470	23.63	1,681	70.12	2,158	100.9	42.44%	40.00%
salema	786	36.429	318	11.26	1,974	126.9	1,157	61.92	65.17%	69.06%
sargo	865	65.289	69	9.485	632	151.5	1,306	269	52.12%	43.77%
yellowfin croaker	662	350.58	187	108.6	255	68.04	422	120	60.09%	64.69%
spotfin croaker	458	53.177	8	1.539	623	162.9	39	13.22	95.83%	93.61%
topsmelt	6	0.188	224	8.789	9	0.416	743	27.93	1.53%	1.62%
jacksmelt	303	28.42	218	19.87	95	8.664	249	20.81	46.01%	47.69%
barred sand bass	148	24.39	72	10.08	191	29.43	248	33.45	51.44%	55.29%
walleye surfperch	51	1.177	105	2.435	121	2.533	183	3.487	37.39%	38.52%
shiner perch			76	1.729	4	0.15	337	12.18	0.96%	1.07%
rockpool blenny			93	0.451	1	0.01	264	0.728	0.28%	0.84%
deep body anchovy			67	0.786			107	1.194	0.00%	0.00%
chub mackerel	97	11.2	12	1.289	25	3.661	15	1.805	81.88%	82.77%
California scorpionfish	21	2.012	40	3.327	14	1.555	60	9.763	25.93%	21.41%
zebra perch	16	11.2			85	36	6	2.6	94.39%	94.78%
kelpbass	17	3.55	8	0.412	27	2.964	53	2.737	41.90%	67.41%
Pacific pompano	37	1.51	12	0.576	20	0.74	25	0.868	60.64%	60.91%
white seaperch	11	0.44	35	0.528	8	0.588	38	0.948	20.65%	41.05%
California corbina	26	3.94	4	0.273	42	4.613	9	0.869	83.95%	88.22%
giant kelpfish	23	1.43	15	0.79	18	1.495	25	1.404	50.62%	57.14%
black perch	10	0.99	47	2.39	1	0.1	15	0.731	15.07%	25.88%
black croaker	12	0.8	19	1.357	8	0.881	22	2.147	32.79%	32.42%
cabezon	1	0.23	17	0.156	2	0.826	37	0.832	5.26%	51.66%
plainfin midshipman			2	0.099	4	0.308	50	3.32	7.14%	8.26%
rock wrasse	6	0.6	18	1.59	1	0.095	27	2.408	13.46%	14.81%
white croaker	1	0.04	15	0.405	1	0.15	29	2.013	4.35%	7.29%
mussel blenny							44	0.184	0.00%	0.00%
senorita	1	0.011	25	0.395			11	0.266	2.70%	1.64%
Pacific barracuda			9	0.237	1	0.02	20	0.61	3.33%	2.31%
slough anchovy			21	0.067			7	0.021	0.00%	0.00%
white seabass	4	0.54	3	0.472	5	6.09	14	1.54	34.62%	76.72%
round stingray	4	0.92	3	1.344	5	2.45	9	2.98	42.86%	43.80%
kelp pipefish			4	0.032			15	0.134	0.00%	0.00%
blacksmith	1	0.035	6	0.181	2	0.13	8	0.212	17.65%	29.57%
dwarf perch			10	0.14			5	0.07	0.00%	0.00%
kelp perch			6	0.112			9	0.146	0.00%	0.00%
specklefin midshipman			2	0.425			13	0.631	0.00%	0.00%
spotted kelpfish			8	0.093			7	0.08	0.00%	0.00%
basketweave cusk-eel			6	0.171	1	0.02	7	0.24	7.14%	4.64%
shovelnose guitarfish	3	8.55	10	5.38			1	5.2	21.43%	44.69%

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Common Name	Unit 2 Fish Chase		Unit 2 Heat Treat		Unit 3 Fish Chase		Unit 3 Heat treat		% Returned by Count	% Returned by Biomass
	Number	Kgs	Number	Kgs	Number	Kgs	Number	Kgs		
horn shark	8	11.95	2	2.776	3	11			84.62%	89.21%
rubberlip seaperch			3	0.033	1	0.3	9	1.11	7.69%	20.79%
giant seabass	4	125	1	42	7	205			91.67%	88.71%
California grunion			2	0.029			9	0.128	0.00%	0.00%
brown rockfish	2	0.17	2	0.316			6	1.646	20.00%	7.97%
California halibut							9	1.131	0.00%	0.00%
spotted turbot			2	0.021			6	0.046	0.00%	0.00%
grass rockfish			7	0.376					0.00%	0.00%
speckled sanddab			2	0.02			5	0.034	0.00%	0.00%
California electric ray					2	47	4	34.05	33.33%	57.99%
vermilion rockfish			4	0.012			2	0.012	0.00%	0.00%
bocaccio			3	0.035			2	0.026	0.00%	0.00%
California lizardfish	2	0.07			1	0.1	2	0.007	60.00%	96.32%
California butterfly ray	2	35.3	1	0.133			1	0.123	50.00%	99.28%
calico rockfish							3	0.024	0.00%	0.00%
garibaldi					2	0.45	1	0.15	66.67%	75.00%
Pacific bonito					3	0.42			100.00%	100.00%
pile perch	1	0.15	2	0.111					33.33%	57.47%
barred surfperch							2	0.094	0.00%	0.00%
bat ray	1	30			1	15			100.00%	100.00%
Artedius sculpin, unid.					1	0.01			100.00%	100.00%
barcheek pipefish			1	0.001					0.00%	0.00%
calico sculpin							1	0.018	0.00%	0.00%
California tonguefish	1	0.01							100.00%	100.00%
coralline sculpin					1	0.025			100.00%	100.00%
Dover sole							1	0.011	0.00%	0.00%
finescale triggerfish			1	0.71					0.00%	0.00%
halfmoon					1	0.4			100.00%	100.00%
hornyhead turbot							1	0.022	0.00%	0.00%
onespot fringehead							1	0.008	0.00%	0.00%
Pacific herring							1	0.028	0.00%	0.00%
painted greenling							1	0.091	0.00%	0.00%
Pacific staghorn sculpin			1	0.034					0.00%	0.00%
smoothhound, unid.	1	0.25							100.00%	100.00%
spotted sand bass							1	0.28	0.00%	0.00%
thornback	1	1.2							100.00%	100.00%
yellow snake eel							1	0.213	0.00%	0.00%
	8,796	1,111.4	13,307	575.5	14,491	1,325	39,457	1,441		

APPENDIX H.

Species of Special Interest Impinged or Entrained During 2009

Many researchers and resource managers have found impingement data to be a valuable tool in providing data on the dynamics of marine organisms in near-shore coastal waters. Though not a required part of this marine environmental monitoring report, the following information is provided for those who may be interested in these species:

Appendix H. Species of Special Interest Impinged in 2009

(Actual number observed, not scaled for flow)

Fish Species	Reason for concern	Heat Treatment	Normal Operation	Fish Chase
	Fish			
California halibut	Important sport and commercial fish	9	2	0
Cabezon	Species of special concern	54	0	3
Bocaccio	Species of special concern	4	2	0
Giant seabass	Protected in California	1	0	11
Kelp bass	Important recreational fish	61	0	44
White seabass	Important sport and commercial fish	17	16	9

Mammal & Turtle Species	Reason for concern	Returned Alive	Found Dead
	Mammals and Turtles		
California sea lion	Marine Mammal Protection Act	1	19
Harbor seal	Marine Mammal Protection Act	4	9
Green Sea Turtle	Endangered Species Act	1	0
Olive Ridley Sea Turtle	Endangered Species Act	1	0